

# Low AC-loss MgB<sub>2</sub> Superconductors for Turbo-electric Aircraft Propulsion Systems, Phase I

Completed Technology Project (2009 - 2009)



## Project Introduction

The development of magnesium diboride (MgB<sub>2</sub>) superconducting wires makes possible the potential to have much lighter weight superconducting stator and rotor coils for heavy aircraft motors and generators than with any other metal or ceramic superconductor. The MgB<sub>2</sub> superconductor can be cooled to 20 K by liquid hydrogen fuel or conductively with a cryocooler. The lighter weight coils, especially in the stator, will enable a lighter weight motor/generator. In a NASA SBIR Phase I and Phase II program we want to develop low AC loss MgB<sub>2</sub> superconductors for the stators of synchronous motors or generators. For turbo-electric aircraft propulsion systems, it is desirable to have very light weight superconducting wires that can operate at greater than 1.5 T field and 500 Hz electrical frequency with input power between 10 and 100 kW. This SBIR Phase I aims to design, fabricate, and characterize AC-tolerant superconductors with a targeted loss budget less than 10 W/kA-m. This will be accomplished by reducing the hysteretic losses in MgB<sub>2</sub> superconductors by fabricating wires with very small filaments, reducing the eddy current component of AC losses in MgB<sub>2</sub> superconductors, and characterizing the transport current and AC losses of MgB<sub>2</sub> wires.

## Anticipated Benefits

Potential NASA Commercial Applications: Manufacturers of large electrical systems desire to increase the efficiency, and decrease the size and weight of their systems in order to reduce costs. Presently manufacturers of transformers, motors, generators, fault current limiters, transmission cables, and magnetic resonance imaging (MRI) systems are pursuing superconductor wires to achieve these objectives. To make major cost improvements with superconducting systems, the barriers have been the higher cost of cooling at liquid helium temperature (4 K) for traditional metallic superconductors and the high wire cost for ceramic high temperature superconductors at 20-30 K temperatures. Low cost MgB<sub>2</sub> superconductor wires operating at 4-25 K can overall lower the upfront and ongoing operational costs of superconducting systems. Potential Non-NASA Commercial Applications: Besides stator and rotor coils, magnesium diboride superconductors can benefit NASA applications for many applications where light weight power components are required such as cables, generators, motors, transformers, inductors, and power conditioning equipment. Other magnet applications that magnesium diboride wires can be considered for are magnetic shielding in space applications, ADR coils, magnetic bearings, actuators, MHD magnets, and magnetic launch devices.



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Superconductors for Turbo-  
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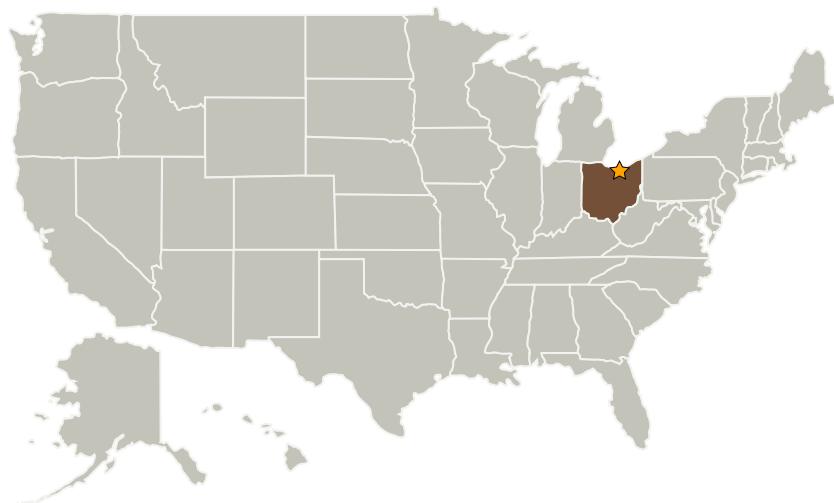
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Hyper Tech Research, Inc.	Supporting Organization	Industry	Columbus, Ohio

## Primary U.S. Work Locations

Ohio

## Project Transitions

 **January 2009:** Project Start **July 2009:** Closed out**Closeout Summary:** Low AC-loss MgB<sub>2</sub> Superconductors for Turbo-electric Aircraft Propulsion Systems, Phase I Project Image

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Glenn Research Center (GRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Gerald V Brown

**Principal Investigators:**

Matt Rindfleisch

Matthew Rindfleisch

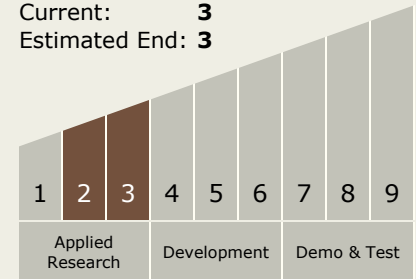
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## Technology Maturity (TRL)

Start: 2  
Current: 3  
Estimated End: 3



## Technology Areas

### Primary:

- TX03 Aerospace Power and Energy Storage
  - └ TX03.3 Power Management and Distribution
    - └ TX03.3.2 Distribution and Transmission